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Reservoir Engineering Fundamentals: Essentials Course

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Introduction:

Reservoir Engineering Fundamentals Essentials Course content covers reservoir engineering, the discipline that estimates how much oil and gas a reservoir holds, how those fluids flow through porous rock and how much can be recovered over time. This 1-week course is for petroleum, reservoir and production engineers, geoscientists and technical staff new to the discipline, and its final deliverable is a reservoir engineering workbook for a case field. It is taught at foundation practitioner level through a modelling build with worked calculations, and it uses the SPE Petroleum Resources Management System PRMS, the industry classification for reserves and resources.

Course Objectives:

- Define porosity, permeability, saturation and wettability and interpret the core and log values used in reservoir calculations
- Distinguish oil and gas formation volume factors and apply PVT data to convert surface volumes to reservoir conditions
- Apply deterministic and probabilistic volumetric methods to estimate oil and gas initially in place
- Interpret material balance plots to compare solution gas drive with water drive and gas cap drive behaviour
- Select a suitable Arps decline model and interpret drawdown and buildup test results for permeability and skin
- Justify the classification of volumes as reserves, contingent resources or prospective resources under PRMS

Target Audience:

- Engineers moving into reservoir studies from drilling, completions or facilities roles, deciding which reservoir data and methods apply to a field question
- Production engineers who monitor well rates and pressures, judging whether a decline reflects reservoir depletion or a well problem
- Geoscientists who build maps and petrophysical interpretations, deciding which rock and fluid inputs to pass to volumetric estimates
- Junior reservoir and petroleum engineers who prepare in-place and recovery estimates, choosing between volumetric, material balance and decline methods
- Technical staff who compile PVT, well test and production data, judging which records are fit for engineering calculations

Course Outline:

Day 1: Reservoir Rock and Fluid Basics: Porosity, Permeability, Saturation and Phase Behaviour

- Absolute vs Effective Porosity: Pore Space Definitions Used in Volumetric Calculations
- Darcy's Law and Permeability: Measuring Flow Capacity From Core and Logs
- Fluid Saturation and Capillary Pressure: Transition Zones and Free Water Level
- Wettability and Relative Permeability: Controls on Oil, Gas and Water Flow
- Reservoir Fluid Types: Black Oil, Volatile Oil, Gas Condensate and Dry Gas

Day 2: PVT Properties and Hydrocarbon Volumes: Fluid Models and Volumetric Estimates

- Oil Formation Volume Factor vs Gas Formation Volume Factor: Surface-to-Reservoir Conversion
- Solution Gas-Oil Ratio and Bubble Point: Reading a Laboratory PVT Report
- Gas Z-Factor and Real Gas Law: Correcting Gas Volumes for Pressure
- Volumetric STOIIP and GIIP: Area, Net Pay, Porosity and Saturation Inputs
- Deterministic vs Probabilistic Volumetrics: P90, P50 and P10 Ranges Explained

Day 3: Applying Material Balance, Drive Mechanisms and Reserves Classification

- General Material Balance Equation: Tank Model Assumptions and Underground Withdrawal Terms
- Havlena-Odeh Straight-Line Method: Identifying Initial Oil in Place From Production
- Gas Reservoir p/z Plot: Estimating Original Gas in Place and Recovery
- Solution Gas Drive vs Water Drive: Pressure and Recovery Factor Signatures
- SPE Petroleum Resources Management System PRMS: Reserves, Contingent and Prospective Resources

Day 4: Production Forecasting, Well Test Basics and Recovery Options Compared

- Arps Decline Curve Analysis: Exponential, Hyperbolic and Harmonic Decline Models
- Drawdown vs Buildup Tests: Pressure Transient Data Used to Estimate Permeability
- Horner Plot and Skin Factor: Diagnosing Near-Wellbore Damage or Stimulation
- Numerical Reservoir Simulation Overview: Grid Blocks, Black-Oil Models and History Matching
- Waterflooding vs Enhanced Oil Recovery: Secondary and Tertiary Recovery Options Compared

Day 5: Modelling Build: Reservoir Engineering Workbook for a Case Field

- Case Field Data Review: Quality Checking Core, PVT and Production Records
- Case Volumetric Model Build: Calculating a STOIIP Range From Mapped Inputs
- Material Balance vs Volumetric Estimate: Reconciling In-Place Volumes for the Case
- Case Decline Forecast: Fitting Arps Parameters and Estimating Ultimate Recovery
- Reservoir Engineering Workbook: Completing Volumes, Drive Diagnosis, Forecast and Resource Category

Skills You Will Gain:

- Volumetric In-Place Estimation
- PVT Report Interpretation
- Material Balance Analysis
- Drive Mechanism Diagnosis
- Decline Curve Forecasting
- Pressure Buildup Interpretation
- Resource Classification Under PRMS
- Reservoir Data Quality Checking

Why Attend This Course:

- From using rock and fluid property values supplied by others to checking where they come from and how they change a volume estimate
- From relying on a single in-place figure to presenting P90, P50 and P10 ranges and reconciling them with material balance
- From reading production declines by eye to fitting Arps models and estimating ultimate recovery with stated assumptions
- From scattered spreadsheets to a reservoir engineering workbook covering volumes, drive diagnosis, forecast and resource category for a case field

Conclusion:

Reservoir engineering, put simply, is the quantitative link between what a reservoir contains and what a field can produce. The course makes three distinctions clear: volumetric against material balance estimates of oil and gas in place, solution gas drive against water drive behaviour, and reserves against contingent and prospective resources. It suits engineers, geoscientists and technical staff who need a condensed, calculation-based grounding in reservoir engineering fundamentals within one week, rather than experienced reservoir engineers seeking advanced simulation, integrated asset modelling or enhanced recovery design.

Frequently Asked Questions FAQ:

What should a delegate know before the Reservoir Engineering Fundamentals Essentials Course?

A technical degree or work background in engineering or geoscience, with comfort in basic algebra and spreadsheets, is enough. No prior reservoir engineering experience is assumed. Bringing anonymised field data, such as a PVT report or production history, brings the workbook exercises closer to daily work.

How does the Reservoir Engineering Fundamentals Essentials Course differ from a longer advanced reservoir engineering course?

This course concentrates on core calculations: rock and fluid properties, volumetrics, material balance, decline analysis and well test basics. Longer advanced courses add detailed simulation, reservoir characterisation, integrated asset modelling and enhanced recovery design, which this course introduces only in outline.

In reservoir engineering fundamentals, what is the difference between volumetric and material balance estimates?

A volumetric estimate calculates oil or gas in place from mapped rock volume, porosity and saturation, often before much production. A material balance estimate uses measured pressure and production history, so it reflects the connected volume and becomes more reliable as the field depletes.

What does a delegate take back to work from the Reservoir Engineering Fundamentals Essentials Course?

Delegates take back a reservoir engineering workbook for a case field, with volumetric ranges, a material balance check, a drive mechanism diagnosis, an Arps decline forecast and a resource category under PRMS, reusable as a template for their own fields.